

8. (New) A stretchable raschel-type warp knit fabric as defined in claim 1, wherein the knit fabric is of a combined structure of elastomeric fibers threaded in two thread guide bars and net.

REMARKS

In response to the above Office Action, claim 1 has been amended for clarity and new claims 4-8 added to round out the scope of protection. Claim 5 corresponds to original claim 3 now dependent on claims 1, 2, and 4. Support for new claim 4 can be found on page 8, line 31 to page 9, line 22 and for claims 6-8 on page 5, line 31 to page 6, line 13.

Applicants' invention as set forth in main claim 1 relates to a stretchable raschel-type warp knit fabric:

(a) formed of a ground structure of polytrimethylene terephthalate fiber combined with elastomeric fiber laid-in;

(b) wherein the knitted fabric has the number of courses in a range from 100 to 200 courses per 2.54 cm; and

(c) a product of the number of courses times the number of wales per 2.54 cm is in a range from 4,000 to 8,000.

Based on the features (a), (b), and (c), the present invention provides a stretchable warp knit fabric which is soft in touch, being free from occurrences of grinning and yellowing, and in addition, has excellent heat-moldability.

These features as a whole are required for a stretchable warp knit fabric formed of a ground knit structure of non-elastomeric fiber with bare elastomeric fiber laid-in,

which is a fabric material suitable for making a foundation garment such as a brassiere, a girdle, or a body suit.

Evaluation of "grinning" is performed by immersing a sewed piece of fabric in an aqueous solution of weak alkaline detergent as an imitation of sweat.

In a conventional stretchable warp knit fabric of this type where nylon fiber or polyethylene terephthalate (PET) fiber is used for the ground knit structure instead of polytrimethylene terephthalate (PTT), the whole of the improved features of the present invention are not obtained because of inherent characteristics of nylon fiber or polyethylene terephthalate fibers (see the specification from page 1, line 23 through page 3, line 25). In this regard, see also Table 2 on page 27; Comparative Examples 5 and 6 and their descriptions on page 23, line 6 to page 24, line 7, where nylon fiber is used for the ground knit structures, and Comparative Examples 7 and 8 and their description on page 24, lines 11 through 25, where polyethylene terephthalate fiber is used for the ground knit structures.

In the present invention, features (b) and (c) specify the density of the claimed warp knit fabric as finished in terms of the number of courses and the product of the number of courses (number of courses counted in the direction of fabric) times the number of wales (number of wales counted in the direction of fabric). A stretchable warp knit fabric having these features where the ground knit structure is formed of a PTT fiber is soft in touch while being free of occurrences of grinning and yellowing.

When the knit fabric is knitted either with the number of courses exceeding 200 courses per 2.54 cm, or with a product of the number of courses/2.54 cm times the number of wales/2.54 cm (herein after referred to as knit density) exceeding 8,000, i.e.,

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a high density knit fabric, the fabric exhibits no occurrences of grinning, although the knitted fabric loses its commercial value because the fabric loses its softness in touch and because the elastomeric yarn is liable to be broken. When the knit fabric is knitted with the number of courses being less than 100 courses/2.54 cm or the knit density is less than 4,000, the fabric becomes very soft in touch, but it has occurrences of grinning. See the specification at page 7, lines 4 through 37.

The stretchable warp knit fabric of the present invention can be produced by (1) knitting a grey fabric while increasing a runner length of the polytrimethylene terephthalate yarn and that of the elastomeric yarn to more than in a mixed fiber knit fabric composed of nylon or polyethylene terephthalate fiber and an elastomeric fiber, and decreasing the number of courses, with the runner lengths of the polytrimethylene terephthalate yarn fiber and the elastomeric yarn and the number of courses selected so that the claimed density of knit is reached in the final fabric obtained by scouring the grey fabric; (2) presetting it under tension in the same width direction before dyeing to have substantially the same width and length as those of the dyed fabric; (3) optionally dyeing and finishing the preset fabric; and (4) final-setting the processed fabric.

More specifically, in the case of a stretchable warp knit fabric of a six course satin net structure as set forth in claim 4, the fabric is produced by:

(a) knitting a gray fabric with the number of courses ranging from 65 to 85 courses/2.54 cm by combining a runner length of a front yarn of polytrimethylene terephthalate yarn in a range from 1,250 to 1,350 mm/rack, where 1 rack equals a yarn length necessary for knitting 480 courses, with a back yarn of elastomeric fiber yarn in a

range from 120 to 165 mm/rack and by adjusting a product of the runner lengths of front and back yarns in a range from 150,000 to 215,000;

(b) scouring the grey fabric;

(c) presetting the scoured fabric while widening the scoured fabric so that the product density is in a range from 4,000 to 8,000;

(d) optionally dyeing so that the length and the width are kept unchanged between before and after the dyeing; and

(e) finally setting the fabric while the number of courses and number of wales are kept unchanged.

"Grinning" means a fault appearing on the surface of the fabric resulting from slippage (dislocation) of the non-elastic yarn disposed over the elastomeric yarn in the knit structure under repetition of elongation/relaxation cycles in the warp-wise direction of fabric.

In a stretchable raschel-type warp knitted fabric formed of a ground structure of a knitted yarn combined with elastomeric yarn laid-in, the elastomeric yarn is structurally covered by being wrapped by the non-elastomeric yarn forming the ground structure; the sinker loop of the non-elastomeric yarn covers the elastomeric yarn so as to wrap the elastomeric yarn with a certain tightening (pressing) force produced by the strangling non-elastomeric yarn in the knit structure. When the tightening force of the wrapping non-elastomeric yarn is lacking, the non-elastic yarn occasionally slips or dislocates on the peripheral surface of the elastomeric yarn in the knit structure and causes the elastomeric yarn to come to be seen from the surface of the knit fabric.

Grinning occurs when a stretched or elongated stretchable fabric is subjected to an

application of excessive force, for example, by the putting-on or off of a garment of the fabric or after repeated stretching/shrinking force during use of the garments on a human body, and cannot immediately recover its original unstretched (elongated) state after being stretched. See the specification at page 2, lines 10 to 19.

The occurrences of grinning cannot be ignored when considering the overall performance of a stretchable warp knit fabric which varies with the properties of the non-elastomeric fiber to be combined with the elastomeric fiber. See the specification at page 1, line 35 to page 2, line 9 and on page 2, lines 19 to 25.

Factors affecting the tightening force of non-elastic yarn exerted on an elastomeric yarn in a knitted structure are (1) the elastic recovery of elongation of the non-elastomeric knitting yarn, (2) thermal stress of the yarn, and (3) elongation of yarn in a wet state.

Table A attached shows a comparison of the physical properties of PTT, PET, and nylon fibers. Table B attached is a comparison of recovery of a PTT, PET, and nylon yarn at a certain elongation. Figure A attached is a diagram showing stress-strain curves of PTT, PET, and nylon 6 yarns.

As shown in Figure A, the initial modulus (at 3% elongation) of a PTT yarn does not differ from that of nylon 6 yarn. However, the recovery of the PTT yarn at 20% elongation is far greater than that of nylon yarn. This suggests that an elongated knitted yarn in the grey knit fabric on the knitting machine is more quickly recovered from the tension imparted to the knitting yarn under knitting work. Accordingly, the elastomeric yarn is firmly held by the PTT yarn in the knitted fabric, so that slippage of the non-

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elastic yarn on the elastomeric yarn is efficiently prevented. This means that a softer knitted fabric can be obtained because the knitting can be carried out under low tension.

The thermal stress generated in a PTT yarn is double that of a PET yarn and a nylon yarn. This makes the PTT yarn hold the elastomeric yarn tightly in the knitted structure when the knitted fabric is thermally set. When the elastomeric yarn is excessively tightened, it tends to break. For this reason, in a grey fabric of the present invention, it is necessary to knit the mixed fabric by increasing the runner length to yarns to more than in a mixed fiber knit fabric composed of nylon or polyethylene terephthalate fiber and elastomeric fiber, and decreasing the number of courses on the machine.

In the Office Action, the Examiner rejected claims 1-3 under 35 U.S.C. § 103(a) for being obvious over Kondou et al. (Kondou) in view of Kimura et al. (Kimura), and also for being obvious over Kondou in view of Hirt et al. (Hirt).

Kondou describes an improved stretchable raschel-type warp knit fabric obtained by inserting an elastomeric yarn into sinker loops of a ground knit structure formed of non-elastomeric yarn. See column 7, lines 5-15.

The improved stretchable warp knit fabric has bulge sinker loops with a specifically defined shape and is formed by a non-elastic yarn and has a pulling out force of the elastic yarn from the fabric of greater than 30 g at a pulling speed of 10 cm/min. The fabric is said to have a superior balance between wale elongation and course elongation and the ability of being sewn without consideration of cutting direction of the knitted fabric and has no fabric distortion. See column 3, line 59 to column 4, line 20.

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A De Mattia type stretch tester is used for measurement in evaluation of the distortion of stretchable warp knit fabric (see column 12, line 60 to column 13, line 3). This evaluation test corresponds to the present "Evaluation of grinning test" but it is noted that the measurement of Kondou is carried out on a non-sewn piece of unfinished fabric, while measurement in the present invention is carried out on a sewn piece of sample fabric immersed in an imitated sweat (see the specification at page 13, lines 2 to 25).

The fabric of Kondou is prepared by applying to a grey fabric at least one of steam, water, and air applied in a dyeing machine, using a flowing gas as energy for propelling the fabric, applying a wet heat process comprising a scouring treatment and a dyeing treatment to the relaxed grey fabric in the flowing gas dyeing machine, and finally, applying a finishing set to the obtained knitted fabric (see column 10, lines 3 to 23 of Kondou).

The knit fabric can be a satin net such as a four course satin net, a six course satin net, a ten course satin net; and power net (column 7, lines 19-23 of Kondou).

The elastic yarn can be a polyurethane based yarn, preferably having a denier of 490 or less and a breaking elongation of between 500 and 800% (see column 5, lines 55-64 and column 6, lines 23 to 24). The non-elastomeric yarn can be a filament yarn or spun yarn of synthetic fiber such as a polyamide fiber and a polyester fiber. The synthetic fiber preferably has an initial modulus of between 35 g/d and 50 g/d, a breaking tenacity of between 10 and 50 g/d, and elongation at break of 10 to 60% (see column 6, lines 25 to 35).

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The knit fabric embodiments described in the Examples are six-course satin net knit formed of polyamide yarn, especially polyhexamethylene adipamide type polyamide (nylon 66) filamentary yarn and polyurethane elastomeric fiber.

Thus, in summary, while Kondou teaches the use of a "polyester yarn" in combination with an elastic yarn in a stretchable knitted structure of the type contemplated by applicants, it does not indicate any specific type of polyester fiber, and particularly not polytrimethylene terephthalate yarn. Moreover, there is a description in Kondou of the knit density of the knit fabric. Therefore, Kondou fails to teach in a stretchable warp knit fabric any of the presently claimed features (a), (b), and (c), all of which are set forth in main claim 1.

Kimura et al. describes a high twist polyester multifilament yarn for use in producing a woven or knitted crepe fabric having a desirable pebble configuration. The polyester multifilament yarn consists essentially of a copolymer of two or more monomers selected from the group consisting of ethylene terephthalate, trimethylene terephthalate, and tetramethylene terephthalate and/or a blend of two or more polymers of the respective monomers, and has a breaking elongation of not more than 60% and shrinkage in boiling water of not more than 6%. The multifilament yarn is imparted with high twist and then the highly twisted yarn is subjected to a twist setting treatment. It is then converted into a woven or a knitted yarn and is subjected to a pebbling treatment.

As discussed above, in the present invention, the knit densities as specified in claim 1 are crucial to obtaining the desired strength, and surface appearance including the lack of occurrences of ginning, softness in touch, and basis of weight of the as-finished fabric. The present fabric is achieved through the use of a grey fabric which is

prepared by knitting the yarns in a runner length/rack more than in a knitted fabric composed of nylon or PET yarn and decreasing the number of courses on the knitting machine (see the specification on page 6, line 24 to page 7, line 30 and on page 8, line 7 to page 9, line 30).

To produce the fabric of the present invention of PTT fiber yarn, the grey fabric should be knitted specifically in an increased runner length (for example, in the case of six course satin net structure as set forth in claim 3; 1,250 to 1,350 mm/rack for the PTT yarn, 120 to 165 mm/rack for the elastomeric yarn) compared to a grey fabric formed of nylon yarn or PET yarn. This makes the finished fabric free from occurrences of grinning while preventing a finished knitted fabric from losing the softness in touch which is inherent to PTT fiber yarn. Unless the increased runner length/rack is used during knitting, the PTT yarn forming the ground knit structure holds and tightens the elastomeric yarn laid therein with excessive tightening force due to the greatness of the recovery of the PTT yarn at 20% elongation and the thermal stress of PTT yarn (double as much as those of nylon yarn and PET yarn).

Applicants understand that the knit densities of a Kondou knit fabric formed of nylon yarn or polyester must be adjusted during the series of treatment of grey fabric, including the relaxation treatment. However, Kondou is silent about what level of knit densities are needed to enable a finished knit fabric formed of a PTT yarn to be free from occurrences of grinning while making the best use of the softness in touch of PTT fiber and achieving the other features desired. The specific embodiments of the knit fabric described in Kondou are all limited to knit fabric formed of nylon 66 drawn multifilament yarn. As noted, characteristics relating to knitting ability and end-use

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performances of knitted fabric of nylon yarn are very much different from a polytrimethylene terephthalate fiber yarn (see Table A, and especially the differences in initial modulus, elastic recovery at 20% elongation, thermal stress, and moisture regain).

In the following table, runner length/rack of knitting conditions of grey fabrics (a six course satin net structure) formed of various non-elastomeric yarns, PTT, nylon, and PET yarns are compared.

	Front guide Yarn; mm/rack	Back guide Yarn; mm/rack	Grinning rating	Yellowing rating	Mold- ability
EX 1	PTT; 1270	PU; 155	5	5	O
CEX 5	N6; 1270	PU; 155	1	2	X
CEX 6	N6; 1135	PU; 98	5	2	X
CEX 7	PET; 1270	PU; 155	1	5	X
CEX 8	PET; 1135	PU; 98	4	5	X
EX 1 (Kondou)	N66; 1120	PU; 80	-	-	-

Note: EX = Example, CEX = Comparative Example, PTT = polytrimethylene terephthalate, N6 = nylon 6, PET = polyethyleneterephthalate, N66 = nylon 6, and PU = elastomeric polyurethane.

Example 1 is shown in Table 1 on page 26. Comparative Examples 5-8 are shown in Table 2 on page 27. Moldability characteristics are shown on page 15, lines 6-9 of the specification. The knit fabric of Example 1 of Kondou is from a grey fabric which is prepared by knitting nylon 66 yarn as the elastomeric yarn and polyurethane yarn as the elastomeric yarn at a runner length of 1120 mm/rack (front guide, nylon 66 yarn) and at a runner length of 80 mm/rack (back guide, the polyurethane elastomeric yarn). This is close to the fabric of Comparative Examples 6 and 8.

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While the Examiner may believe it would be obvious to substitute the PTT fiber taught by Kimura for the "polyester fiber" taught by Kondou, it can be seen from the above data that this is clearly not suggested by either of the references in view of the above comparative results. Note that when PET yarn, which is a polyester yarn, as well as nylon yarn as the non-elastomeric yarn and polyurethane yarn as the elastomeric yarn are knitted together in the same manner as a PTT yarn with a polyurethane yarn, the projection of grinning and moldability with PET and nylon yarn are significantly worse, and in the case of nylon yarn, also the property of yellowing. How then can it be said that it would be obvious to use PTT as the "polyester fiber" of Kondou at the claimed densities, when the results obtained with respect to grinning, yellowing, and moldability are far superior than when PET is used as the polyester fiber at the same densities? Thus, contrary to the Examiner's position and in view of these results, it cannot be said that it "would have been desirable to have 100 to 200 courses and 4,000 to 8,000 wales per 2.54/cm," when PTT is used as the non-elastomeric yarn.

Kondou does not teach using PTT yarn at the claimed densities in a stretchable raschel-type warp knit fabric and Kimura does not teach that if it was used, one would obtain the properties applicants obtain. As noted, feature (b) (the number of courses/2.54 cm) and feature (c) (knit product 4,000 to 8,000/2.54 cm) results in a structure for the knitted fabric in which PTT yarn tightly covers the elastomeric yarn laid therein without the fabric losing its softness in touch, thereby providing the stretchable fabric with an appearance free from the occurrence of grinning, even when it is sewn as well as the other noted beneficial properties. Thus, it cannot be said that one of ordinary skill in the art would expect the results of the present invention from the

teachings of Kondou and Kimura, and consequently, the combination of these references as proposed by the Examiner comes only from applicants' specification and not from anything taught by these references.

As noted by the Federal Circuit and as expressed, for example, in Interconnect Planning Corp. v. Feil, 774 F.2d 1132, 227 U.S.P.Q. 543 (Fed. Cir. 1985) at page 551:

When prior art references require selective combination by the court to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gleaned from the invention itself.

Further, in Uniroyal, Inc. v. Rudkin-Wiley Corp., 837 F.2d 1044, 5 U.S.P.Q.2d 1434 (Fed. Cir. 1988), the court noted:

Something in the prior art as a whole must suggest the desirability, and thus the obviousness, of making the combination. [837 F.2d at 1051, 5 U.S.P.Q.2d at 1438, citing Lindermann, 730 F.2d 1452, 1462, 221 U.S.P.Q. 481, 488 (Fed. Cir. 1984).]

or the more recent case of In re Kotzab, 217 F.3d 1365, 1369-70, 55 U.S.P.Q.2d at 1313, 1316 (Fed. Cir. 2000):

A critical step in analyzing the patentability of claims pursuant to section 103(a) is casting the mind back to the time of the invention, to consider the thinking of one of ordinary skill in the art, guided only by the prior art references and the then-accepted wisdom in the field. Close adherence to this methodology is especially important in cases where the very ease with which the invention can be understood may prompt one to fall victim to the insidious effect of a hindsight syndrome wherein that which only the invention taught is used against its teacher.

Most if not all inventions arise from a combination of old elements. Thus, every element of a claimed invention may often be found in the prior art. However, identification in the prior art of each individual part claimed is insufficient to defeat patentability of the whole claimed invention. Rather, to establish obviousness based on a combination of the elements disclosed in the prior art, there must be some

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motivation, suggestion or teaching of the desirability of making the specific combination that was made by the applicant. [citations omitted]

Where is the "desirability" suggested in either reference of making the substitution suggested by the Examiner? If the substitution of the PTT yarn of Kimura resulted in a fabric having the same properties as a fabric of PET or nylon yarn, the substitution might well be considered obvious, but when the substitution results in an unexpected and better result as demonstrated above, it cannot be considered obvious. As noted by the court in In re Dow Chemical Co., 837 F.2d 469, 5 U.S.P.Q.2d 1529 (Fed. Cir. 1988) "both the suggestion of the invention and the expectation of its success must be found in the prior art" (emphasis added). See also M.P.E.P. § 716.02(a).

Hirt describes a process for coloring polytrimethylene terephthalate fiber with a disperse dye in the absence of a carrier and the application of pressure, i.e., at a temperature not exceeding 100°C. Numerous examples of stretched polytrimethylene terephthalate fibers from various examples of the polymers are described together with their tensile properties. The examples of dyeing fabric are carried out using the stretched fiber converted to knitted fabrics in the form of knitted hose (10 cm in diameter) knitted by a circular knitting machine.

However, there is no teaching in Hirt of dyeing a PTT yarn that is combined in a knitted fabric with another fiber yarn. Thus, it is submitted that for all the reasons set forth above, it would be no more obvious in view of Hirt to use PTT yarn in the fabric of Kondou that it was with Kimura.

Reconsideration of the rejections based on the cited combination of references and allowance of claims 1, 2, and 4-8 is requested.

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In view of the foregoing amendments and remarks, Applicant respectfully requests the reconsideration and reexamination of this application and the timely allowance of the pending claims.

Please grant any extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

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Dated: June 4, 2003

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Table A Comparisons of Fiber characteristic

	PTT	PET	N6	N66
Melting point (°C)	230	258	220	260
Glass transition point (°C)	51	69	78	76
Density (g/cm ³)	1.34	1.38	1.14	1.14
Moisture regain (%)	0.4	0.4	4.5	4.5
Tenacity (g/d)	3.8 - 4.2	4.2 - 4.8	4.7 - 5.1	5
Elongation %	36 - 42	30 - 38	32 - 44	38
Initial Modulus (at 3% elongation)	25	84 - 95	30 - 32	52
Elastic recovery (at 20% elongation)	88	25 - 26	64 - 65	62
Thermal stress (g/d)	0.38 - 0.45	0.16 - 0.18	0.19 - 0.21	0.25
Shrinkage at boiling water	11 - 14	6 - 8	9 - 11	7
Birefringence $\times 10^{-3}$	1.64	1.7		1.58

PTT: Polytrimethylene terephthalate

PET: Polyethylene terephthalate

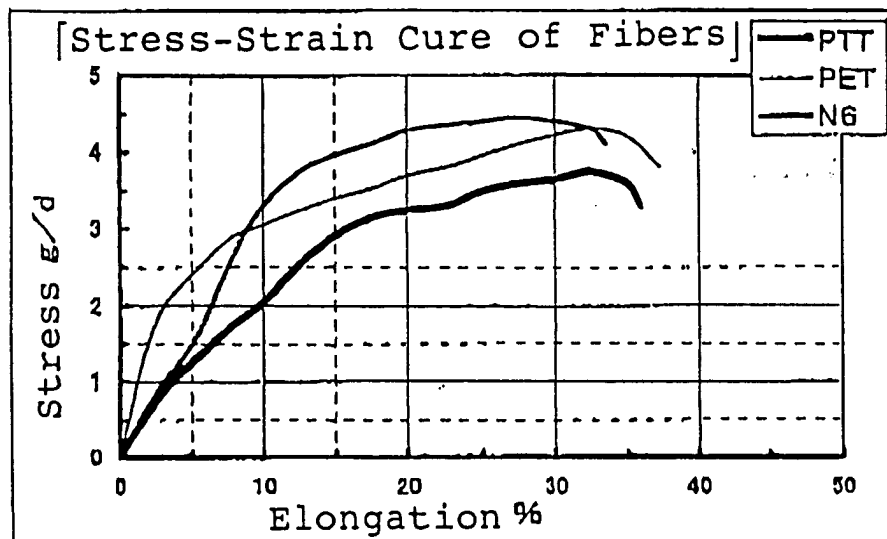
N6: Nylon 6 (Polycapramide)

N66: Polyhexamethylene adipamide

Table B Comparison of recoveries at elongations (%), and stress at stated elongations

		Producer's yarn		
		5% elongation	10% elongation	20% elongation
PTT	Recovering (%)	100	100	88
50d/24f	Stress (g/d)	1.2	2.1	3.3
PET	Recovering (%)	42	45	25
50d/24f	Stress (g/d)	2.3	3.1	3.7
N6	Recovering (%)	100	95	65
70d/24f	Stress (g/d)	1.5	3.3	4.2

Figure A



APPENDIX TO AMENDMENT OF JUNE 5, 2003

Version with Markings to Show Changes Made

Amendments to the Claims

1. (Amended) A stretchable raschel-type warp knit fabric formed of a ground structure of polytrimethylene terephthalate fiber combined with elastomeric fiber laid in, wherein the knit fabric has the number of courses in a range from 100 to 200 courses per 2.54 cm, and a product of the number of courses [and] times the number of wales per 2.54 cm is in a range from 4,000 to 8,000.